# Double Seat - Balanced Valve - Bronze (Type DB) or Stainless Steel Trim (Type DS)

# Technical Instructions

## Description ■

The Powers #11 Double Seat Balanced Valve Regulator (Bronze or Stainless Steel trim) is a self-actuating control valve which automatically controls high temperature fluids at high pressures without the use of external power. Adjust the set point and the rugged self-operating #11 Regulator controls the flow of heating or cooling medium (water or steam) to maintain a constant temperature.

The instrument has a vapor pressure thermal system containing a thermally responsive fluid. This thermal system rapidly senses temperature changes at the bulb and accordingly positions the valve plug, to regulate the flow of the heating or cooling medium to maintain a desired temperature. The thermal system features a two-ply brass bellows with six reinforcing ribs on the bellows head and thick capillary tubing walls to ensure long operating life.

***The Powers #11 DS and DB Regulators feature:***

- A double seated valve for handling high capacities
- A valve stem of highly polished corrosion resistant grade 316L stainless steel to decrease friction and reduce hysteresis
- An adjusting nut mounted on ball bearings and a set point adjusting rod to ease set point adjustments
- A set point reference scale to aid temperature adjustments

## Operation ■

A bulb is connected to a bellows containing a thermally responsive fluid. The bulb is inserted into fluid you are trying to control (process fluid) to sense its temperature. The Regulator set point is adjusted to allow sufficient flow of heating or cooling medium (water or steam) through the valve to keep the process fluid at the desired temperature.

***Direct Acting (heating application)***

**(A)** When the temperature of the process fluid drops below the set point, the temperature of the thermally responsive fluid decreases, which decreases the vapor pressure in the bulb/bellows. The force of the resulting vapor pressure is less than the spring force, so the bellows contract and the spring extends, which raises the valve plug up from its seat. This increases the flow of the heating medium (water or steam), which raises the temperature of the process fluid.

**(B)** As the process fluid temperature increases toward or beyond the desired set point, the temperature of the thermally responsive fluid in the bulb increases, which causes the vapor pressure to increase. This expands the bellows, compresses the spring, and moves the valve plug down and closer to its seat, to reduce or stop the flow of the heating medium.

***Reverse Acting (cooling application)***

**(C)** When the temperature of the process fluid rises toward or above the set point, the temperature of the thermally responsive fluid increases, which increases vapor pressure in the bulb/bellows. The resulting force of the vapor pressure is greater than the spring force, so the spring contracts and the bellows expand to push the valve plug downward, away from its seat. This increases the flow of the cooling medium, which lowers the temperature of the process fluid.

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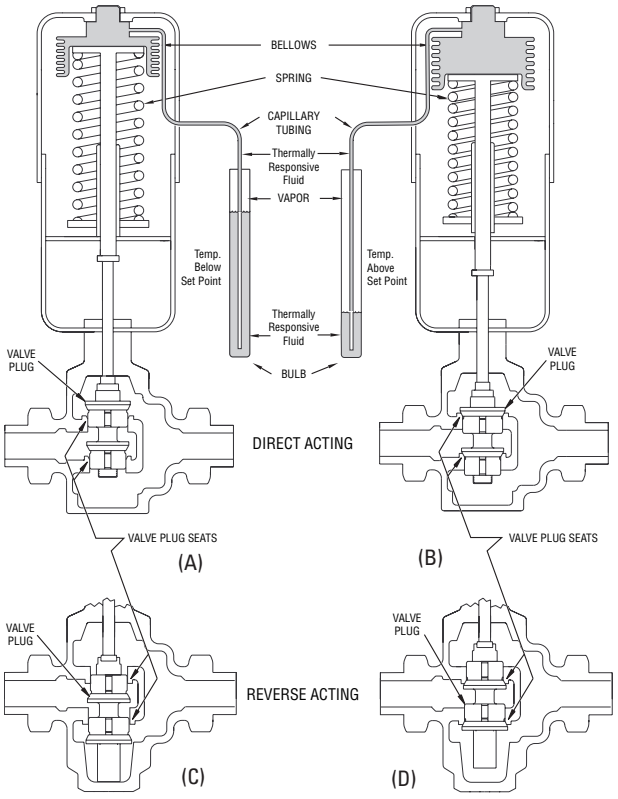


**(D)** As the process fluid temperature decreases toward or below the desired set point, the temperature of the thermally responsive fluid decreases, causing the vapor pressure to decrease. This contracts the bellows and expands the spring to pull the valve plug up towards its seat, to reduce or stop the flow of the cooling medium.

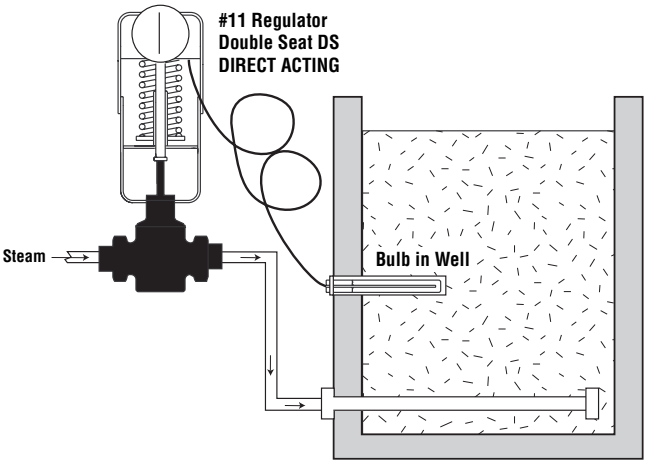
## Specifications ■

| | | Valve Sizes |
|---|---|---|
| | | 1", 1-1/4", 1-1/2", 2" |
| Physical Specs | Valve Plug Travel | See Tables on page 10 |
| | Effective Bellows Area | 7.8 sq. in. (50.3 sq. cm) |
| | Body Material | Bronze |
| | Body Rating | ANSI Class 250 |
| | Connections | Double Female Union w/NPT threads |
| | Style | Double Seat |
| | Max. Body Temperature | 400°F (204°C) |
| Operating Specs | Temperature Range | See order code on page 15 |
| | Controlled Medium | Steam or Water |
| | Max. Differential Pressure | See Tables on page 4 |
| | Max. Allowable Overheat Temp. | 25°F (14°C) above range |
| | Max. Well Safe Pressure | See Table on page 11 |
| | Max. Body Pressure | 250 psi (1724 kPa) |
| | Shipping Weight | See Table on page 10 |
| | Flow Characteristics | Linear |
| | Shutoff Class Rating | ANSI Class II |
| | Leakage | 0.5% rated valve capacity |

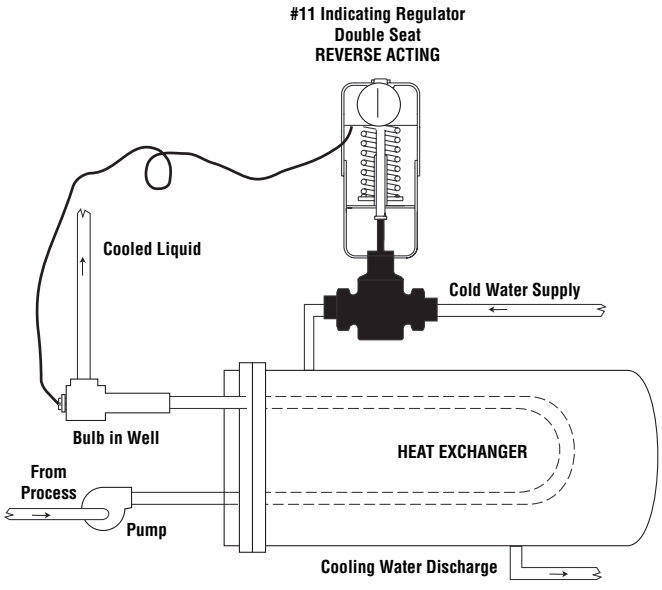
## Applications ■

**Powers #11** Balanced Valve Regulators are used to automatically control hot or cold fluids at pressures up to 125 psi. The self-actuated regulator can easily be installed in any convenient location. Among its applications are: hot water systems, fuel oil heaters, heat exchangers, air drying rooms, and many industrial processes. Below are two typical applications.

Balanced valve regulators are well suited to heating applications where the steam inlet pressure is under 125 psig and good shut-off is not required.




**Quench Tank Application (Heating)**




**Heat Exchanger Application (Cooling)**

## Sizing and Selection ■

Proper sizing of the Regulator is essential for correct system operation. An undersized Regulator will not allow sufficient flow at maximum load. An oversized Regulator may cycle and will not utilize the full valve stroke for efficient modulation of flow. This results in poor control and shortened valve life (quicker deterioration of valve plug and seat). For these reasons, the correct sizing of the Regulator for actual expected conditions is considered essential for good control.

**NOTE:** For best valve performance, select a bulb that contains your process set point in the upper third of its temperature range (see page 16).

Size the #11 Regulator for actual rather than maximum conditions. **Do Not** size according to piping conditions; piping systems are designed for different criteria than process controls. Refer to Powers document AE-1—"Valve Selection and Sizing"—for further recommendations.

**Maximum Operating Pressure Differential (differential for fluid flow):** In order for the process medium to flow, a pressure drop must exist across the valve. "Pressure differential" is the difference in valve pressure between the inlet and outlet under flow conditions. The greater the differential, the greater the flow at any given plug position.

Though the regulator should be sized for actual conditions, you need to know the available differential at maximum flow. For optimum control, take as much differential as possible across the valve.

## Water Capacities ■

**Use a pressure drop of at least 25% of inlet pressure when sizing valves for water applications.**

### WATER CAPACITIES --- GPM

| Valve | Available Sizing Pressure Differential --- PSI | | | | | | | | | | | | | | | | Maximum Δp - PSI | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | Cv | 2 | 4 | 6 | 8 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 80 | 100 | 125 | Bronze | SS |
| 1" | 13.5 | 19 | 27 | 33 | 38 | 43 | 52 | 60 | 68 | 74 | 85 | 95 | 105 | 121 | 135 | 151 | 50 | 150 |
| 1-1/4" | 22 | 31 | 44 | 54 | 62 | 70 | 85 | 98 | 110 | 120 | 139 | 156 | 170 | 197 | 220 | 246 | 50 | 150 |
| 1-1/2" | 28 | 40 | 56 | 69 | 79 | 89 | 108 | 125 | 140 | 153 | 177 | 198 | 217 | 250 | 280 | 313 | 50 | 150 |
| 2" | 53 | 75 | 106 | 130 | 150 | 168 | 205 | 237 | 265 | 290 | 335 | 375 | 411 | 474 | 530 | 593 | 50 | 125 |

### WATER CAPACITIES --- L/S

| Valve | Available Sizing Pressure Differential --- kPa | | | | | | | | | | | | | | | | Maximum Δp - kPa | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | 7 | 15 | 30 | 45 | 60 | 75 | 100 | 125 | 150 | 200 | 250 | 350 | 450 | 550 | 650 | 750 | Bronze | SS |
| 1" | 0.9 | 1.3 | 1.8 | 2.2 | 2.5 | 2.8 | 3.2 | 3.6 | 4 | 4.6 | 5.1 | 6.1 | 6.9 | 7.6 | 8.3 | 8.9 | 345 | 1034 |
| 1-1/4" | 1.4 | 2 | 2.9 | 3.5 | 4.1 | 4.6 | 5.3 | 5.9 | 6.5 | 7.5 | 8.4 | 9.9 | 11 | 12 | 13 | 14 | 345 | 1034 |
| 1-1/2" | 1.8 | 2.6 | 3.7 | 4.5 | 5.2 | 5.8 | 6.7 | 7.5 | 8.2 | 9.5 | 11 | 13 | 14 | 16 | 17 | 18 | 345 | 1034 |
| 2" | 3.4 | 4.9 | 7 | 8.5 | 9.9 | 11 | 13 | 14 | 16 | 18 | 20 | 24 | 27 | 30 | 32 | 35 | 345 | 862 |

**Caution:** Do not exceed maximum pressure differentials for given valve sizes. The **maximum differential** is the pressure the valve has against it at shutoff. Too large a differential can cause valve chatter and/or prevent shutoff.

## Steam Capabilities ■

**Use a pressure drop of 50% of absolute inlet pressure (gauge pressure + 15 psi) for steam applications.**

| | Inlet Pressure - PSIG | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | | 5 | | | | 10 | | | | | 15 | | | | 25 | | | | | 50 | | | | |
| Valve | Available Sizing Pressure Differential- PSI | | | | | | | | | | | | | | | | | | | | | | | | |
| Size | 1 | 2 | 1 | 2 | 3 | 5 | 2 | 4 | 6 | 8 | 10 | 2 | 5 | 10 | 15 | 2 | 5 | 10 | 15 | 20 | 10 | 15 | 20 | 32.5 | |
| 1" | 161 | 225 | 176 | 245 | 296 | 372 | 276 | 382 | 457 | 516 | 563 | 304 | 468 | 630 | 732 | 353 | 547 | 747 | 881 | 958 | 980 | 1174 | 1326 | 1572 | |
| 1-1/4" | 263 | 366 | 286 | 400 | 483 | 606 | 450 | 623 | 746 | 841 | 917 | 495 | 762 | 1027 | 1192 | 575 | 891 | 1217 | 1436 | 1562 | 1596 | 1914 | 2161 | 2563 | |
| 1-1/2" | 335 | 466 | 364 | 509 | 614 | 771 | 573 | 792 | 949 | 1070 | 1167 | 630 | 970 | 1307 | 1517 | 732 | 1134 | 1549 | 1828 | 1987 | 2032 | 2436 | 2750 | 3261 | |
| 2" | 634 | 882 | 690 | 963 | 1163 | 1460 | 1084 | 1500 | 1796 | 2026 | 2209 | 1193 | 1836 | 2474 | 2872 | 1385 | 2147 | 2932 | 3459 | 3762 | 3846 | 4611 | 5206 | 6173 | |

**CAUTION:** Do not exceed maximum pressure differentials for given valve sizes. The **maximum differential** is the pressure the valve has against it at shutoff. Too large a differential can cause valve chatter and/or prevent shutoff.

| | Inlet Pressure - PSIG | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Valve | 75 | | | | 100 | | | | 125 | 150 | 175 | 200 | Maximum Δp | |
| Size | Available Sizing Pressure Differential - PSI | | | | | | | | | | | | PSI | |
| 1" | 10 | 25 | 35 | 45 | 10 | 25 | 35 | 57.5 | 70 | 82.5 | 95 | 107.5 | Bronze | SS |
| 1-1/4" | 1167 | 1761 | 2015 | 2187 | 1328 | 2027 | 2338 | 2801 | 3415 | 4029 | 4644 | 5258 | 50 | 150 |
| 1-1/2" | 1902 | 2870 | 3284 | 3564 | 2164 | 3303 | 3811 | 4565 | 5566 | 6567 | 7568 | 8569 | 50 | 150 |
| 2" | 2420 | 3653 | 4180 | 4535 | 2754 | 4203 | 4850 | 5809 | 7083 | 8357 | 9631 | 10905 | 50 | 150 |
| | Always use Stainless Steel trim above 50 psig Inlet Pressure | | | | | | | | | | | | | |

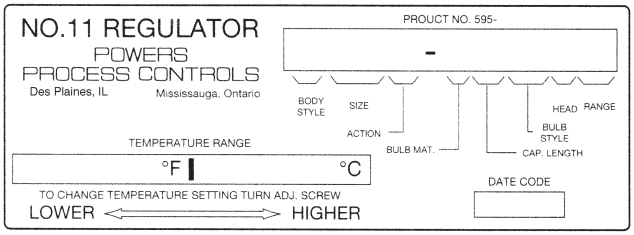
**STEAM CAPACITIES --- KG./HR.**

| | Inlet Pressure - kPa | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | | 30 | | | | 70 | | | | | 100 | | | | 175 | | | | | 350 | | | | |
| Valve | Available Sizing Pressure Differential - kPa | | | | | | | | | | | | | | | | | | | | | | | | |
| Size | 5 | 15 | 5 | 10 | 15 | 30 | 5 | 10 | 15 | 35 | 70 | 10 | 25 | 50 | 100 | 10 | 25 | 50 | 100 | 140 | 10 | 50 | 150 | 250 | |
| 1" | 63 | 107 | 67 | 94 | 114 | 156 | 77 | 108 | 131 | 194 | 258 | 117 | 181 | 248 | 324 | 137 | 214 | 296 | 397 | 448 | 176 | 385 | 627 | 753 | |
| 1-1/4" | 103 | 174 | 109 | 153 | 185 | 254 | 125 | 175 | 213 | 315 | 420 | 190 | 295 | 404 | 529 | 224 | 349 | 482 | 647 | 730 | 287 | 627 | 1021 | 1228 | |
| 1-1/2" | 131 | 221 | 139 | 194 | 236 | 323 | 159 | 223 | 271 | 401 | 534 | 242 | 376 | 514 | 673 | 285 | 444 | 613 | 823 | 930 | 365 | 799 | 1300 | 1562 | |
| 2" | 247 | 418 | 263 | 368 | 446 | 612 | 301 | 422 | 513 | 760 | 1012 | 459 | 711 | 972 | 1274 | 539 | 841 | 1161 | 1558 | 1760 | 692 | 1512 | 2460 | 2957 | |

| | Inlet Pressure - kPa | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 500 | | | | 700 | | | | 850 | 1000 | 1200 | 1400 | Maximum Δp | |
| Valve | Available Sizing Pressure Differential - kPa | | | | | | | | | | | | kPa | |
| Size | 70 | 175 | 250 | 301 | 70 | 175 | 250 | 401 | 476 | 551 | 651 | 751 | Bronze | SS |
| 1" | 525 | 791 | 910 | 971 | 611 | 932 | 1084 | 1294 | 1537 | 1779 | 2102 | 2425 | 345 | 1034 |
| 1-1/4" | 856 | 1289 | 1483 | 1583 | 995 | 1519 | 1767 | 2109 | 2504 | 2899 | 3425 | 3952 | 345 | 1034 |
| 1-1/2" | 1089 | 1640 | 1887 | 2015 | 1267 | 1933 | 2249 | 2685 | 3187 | 3689 | 4359 | 5029 | 345 | 1034 |
| 2" | 2061 | 3105 | 3573 | 3814 | 2398 | 3659 | 4257 | 5082 | 6033 | 6984 | 8252 | 9520 | 345 | 1034 |
| | Always use Stainless Steel trim above 350 kPa Inlet Pressure | | | | | | | | | | | | | |

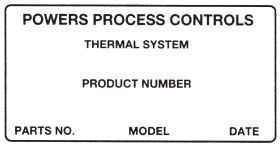
## Product Identification ■

A red label should be on the front face of the thermal system, **(Figure 1.)** This label contains information required to properly maintain, service and order parts for this product. If there is no label, look for a white label on the inside of the thermal system

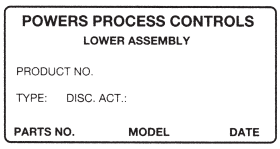



1. Product label

legs **(Figure 2A)** or the valve body vertical yoke **(Figure 2B)**. When replacing the original thermal assembly or valve body, secure the old red label onto the valve or thermal system or ink the number onto the body.




2A. Thermal system label




2B. valve body label

## Installation ■

### *Tools Needed*

- Straight slot screwdriver
- 3/8" open end wrench
- 13/16" open end wrench
- 5/16" open end wrench
- 7/16" open end wrench
- 1-3/8" open end wrench

### *Position Valve*

1. To insure proper system operation, thoroughly flush all piping and valves to rid them of all scale, dirt and debris.

2. Select valve location with sufficient clearance to allow maintenance. Install valve in line. The direction of the arrows on the valve body must match the direction of the water or steam flow.

   For best results, we recommend installing the valve in a horizontal line, and in the upright position with bellows head above valve. The valve may also be installed in any position within 90° of upright.

### *Install Bulb*

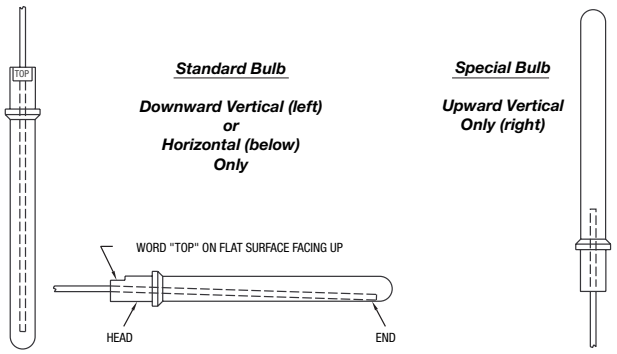
3. **Figure 3A** shows proper bulb orientation. Figure 3B shows the special bulb needed for upwards vertical positioning.

4. **Figure 4** For any position, fully immerse the bulb in the flow of the medium.

   These instructions are for D style bulbs - for installation of other styles, refer to tag attached to bulb.

5. Without a well: Remove bushing from the bulb and screw it into the tank. Insert the thermostatic bulb through the bushing and tighten the union nut.

   With a well: Do not use bushing. Screw well into tank, insert bulb directly into well, and tighten union nut.

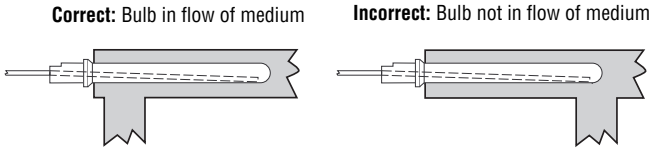



3A. bulb orientation

3B. special bulb

### *Adjust Capillary Tubing*

6. Coil the extra capillary, and position away from regulator operation where it is subjected to room temperature only.




4. bulb position

### *Adjust set point*

*All regulators are factory set to control near mid-range operating temperature.*

> **WARNING: DO NOT** kink, cut, sever or file the tubing. **DO NOT** disconnect tubing from bulb or bellows assembly. This can render the thermal system inoperable and result in severe process overheating.

7. When adjusting the set point, make certain the heating or cooling medium is flowing through the valve and is at the operating pressure of the system.

8. **Figure 5.** Make all set point temperature changes by inserting the temperature adjustment rod into one of the holes of the adjusting nut assembly. (Use the temperature adjustment setting scale only for reference)

   To Raise The Set Point: Turn rod left to right (counterclockwise from top).

   To Lower The Set Point: Turn rod right to left (clockwise from top).

5. adjusting set point

## Maintenance ■

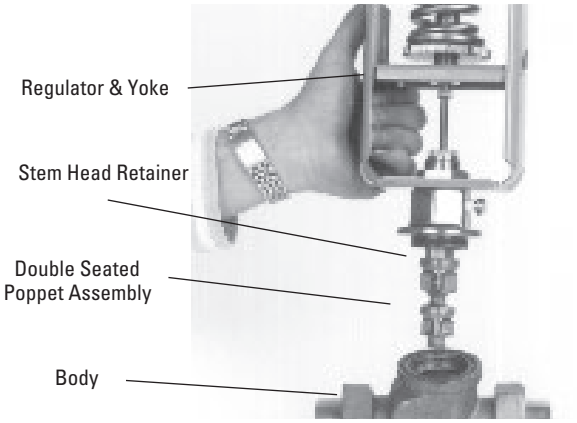
### *DA: To only replace the valve plug*

1. Before disassembly, the bulb must be cooled 30°F (16°C) below the lowest point on the thermal system range, and flow through the valve must be stopped.

2. **Figure 5.** Relieve all pressure on the spring by turning adjusting nut assembly [31] fully right to left (clockwise from top).

3. **Figure 6A. 1" to 2" valves:** Use 1-3/8" wrench to loosen lock nut [11]. Then, use 1-3/8" wrench to unscrew bonnet [20] from valve body [26]. DO NOT ALLOW the regulator top to rotate.

   Lift up regulator top.




6A. (DA, 1" to 2" ) lift off regulator from valve body

5. Remove stem retainer [22] and replace poppet assembly [24]

6. 1" to 2" valves: Install a new gasket [21] between bonnet and valve body.

7. Replace bonnet and stem into valve body.

8. With valve plug firmly seated, screw stem extension [4] to the dimension shown in Figure 15 and tighten into place with hex nut [12].

9. Assemble in reverse order.

### *DA/RA: To fully disassemble regulator from valve*

1. Before disassembly, the bulb must be cooled 30°F (16°C) below the lowest point on the thermal system range, and flow through the valve must be stopped.

2. **Figure 5.** Relieve all pressure on the spring by turning adjusting nut assembly [31] fully right to left (clockwise from top).

3. **Figure 7.** Remove housing bolts [6] and nuts [7] and temperature adjustment setting scale [8] and lift off thermal system [1] (housing, bellows, capillary, and bulb).

4. **Figure 8.** Using one 3/8" wrench and one 5/16" wrench, carefully loosen and remove piston plate assembly [2,3] from the stem extension [4].

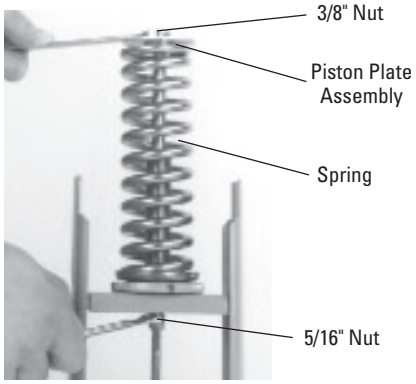
   Lift off spring [19].

5. **Figure 9.** Use 1-3/8" wrench to unscrew lock nut [11] and lift off the yoke and bridge assembly [9].

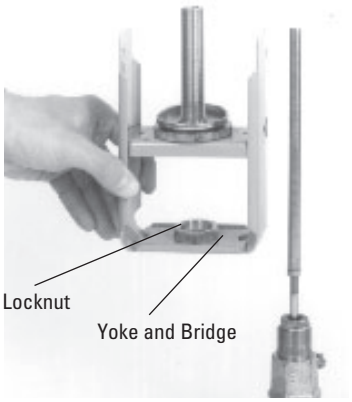
   Follow steps 1-5, To fully disassemble regulator from valve.

7. remove housing and thermal system

### *DA: To replace packing*

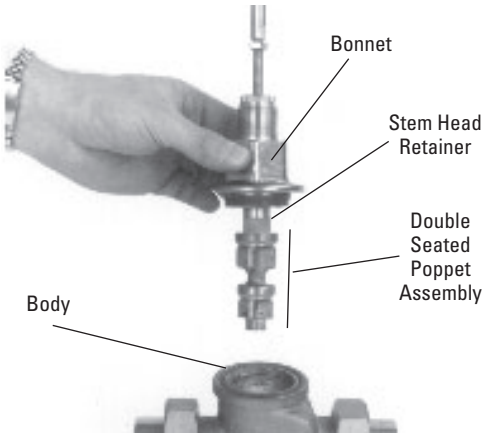



8. remove piston plate/spring




9. lift off yoke and bridge

6. **Figure 10A.1" to 2":** Loosen and remove bonnet [20] from valve body [26].




10A,. (DA, 1" to 2") remove bonnet from valve

7. Carefully pull out poppet [24] and stem assembly [30]. Check the stem. It must have a polished surface that is free of roughness and pitting. Replace any parts if necessary.
8. **Figure 13.** Remove packing gland [14], and all packing components [15a-15e].
9. Clean packing chamber, taking care not to scratch seating surfaces. Be sure chamber is free of dirt and grease.
10. **1" to 2" valves:** Install a new gasket [21] between bonnet and valve body. Replace bonnet [20] and stem [30] into valve body.

    **NOTE:** You must replace the bonnet and stem before attempting to insert the packing. Otherwise, you may tear the packing rings.

11. For standard packing kits, install the parts as shown in Figure 13.

    Slide part(s) [15e], followed by [15d] and [15c] over the stem. Gently push them into the packing chamber.

    **NOTE:** Some kits do not include all the listed packing parts (see page 12), but the order for part installation is the same.

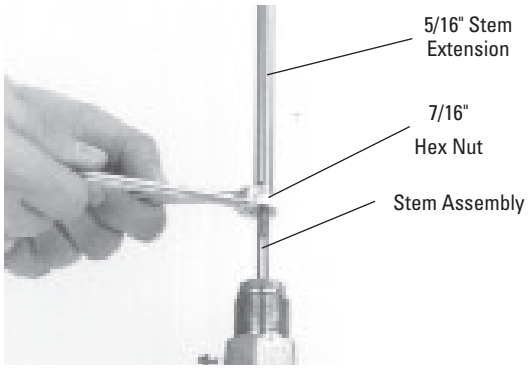
12. For EP V-rings, lubricate the rings first.

    Slide each V-ring [15b] over the stem and carefully push it into the packing chamber.

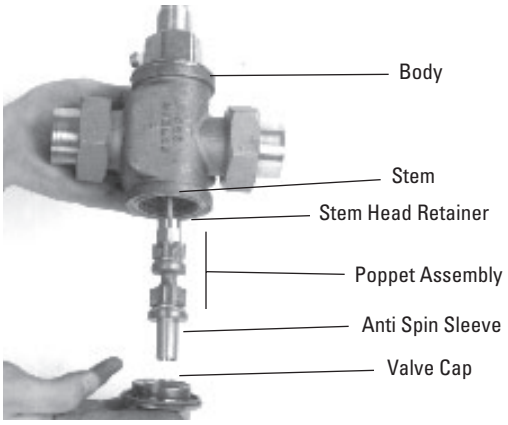
13. Place the packing gland spacer [15a] on top of the bonnet.
14. Thread the packing gland assembly [14] into the bonnet. Tighten the gland assembly against the spacer.
15. With valve plug firmly seated (stem in full down position) screw stem extension [4] to the dimension shown in **Figure 15** and tighten into place with hex nut [12].
16. Assemble the remaining parts in reverse order.

***RA: To replace the valve plug / replace the packing Follow steps 1-5, To fully disassemble regulator from valve.***

1. **Figure 11.** Use a 5/16" wrench on the flats of the stem extension [4] and a 7/16" wrench on the hex nut [12] to loosen and remove them.
2. **Figure 12A. 1" to 2" valves:** Loosen and remove valve cap.




11.(RA) disconnect stem extension from stem

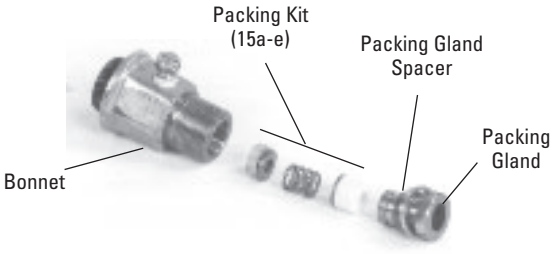



12A. (RA, 1" to 2" ) remove valve cap

Check the stem. It must have a polished surface that is free of roughness and pitting. Replace any parts if necessary.

**3.** Unscrew plug from the stem retainer and replace.

**4.** **Figure 13.** Remove packing gland [14], and all packing components [15a-15e].




13. packing components

**5.** Clean packing chamber, taking care not to scratch seating surfaces. Be sure chamber is free of dirt and grease.

**6.** Insert plug and stem in valve body.

**NOTE:** You must replace the plug and stem before attempting to insert the packing. Otherwise, you may tear the packing rings.

**7.** **1" to 2" valves:** Screw valve cap into place and tighten.

2-1/2" to 4" valves: Install a new gasket [21] between the bottom cap and body. Hold the bottom cap in place and secure with the four cap screws.

**8.** For standard packing kits, install the parts as shown in **Figure 13.**

Slide part(s) [15e], followed by [15d] and [15c] over the stem. Gently push them into the packing chamber.

**NOTE:** Some kits do not include all the listed packing parts (see page 12), but the order for part installation is the same.

**9.** For EP V-rings, lubricate the rings first.

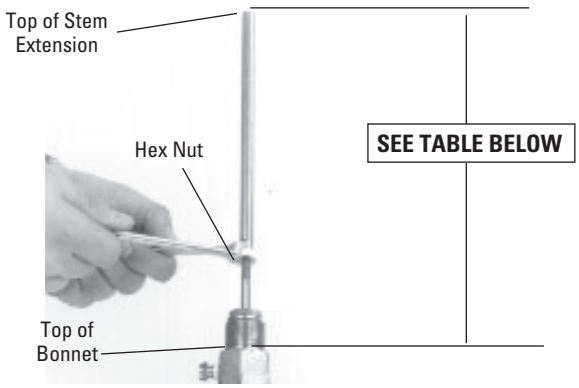
Slide each V-ring [15b] over the stem and carefully push it into the packing chamber.

**10.** Place the packing gland spacer [15a] on top of the bonnet.

**11.** Thread the packing gland assembly [14] into the bonnet. Tighten the gland assembly against the spacer.

**12.** **Figure 14.** With poppet firmly seated (see chart below for position), screw stem extension to the dimension given and tighten into place with hex nut.

**13.** Assemble in reverse order.




| | Stem Setting Dimension (See Above) |
|---|---|
| Valve Action | Valve Size |
| | 1"- 2" |
| DA (Stem DOWN) | 10-1/8" (+1/32, -0) [257mm (+.79, -0)] |
| RA (Stem UP) | 10-11/32" (+0,-1/32) [263mm (+0, -.79)] |

14. Stem extension dimensions

## Testing The Thermal System ■

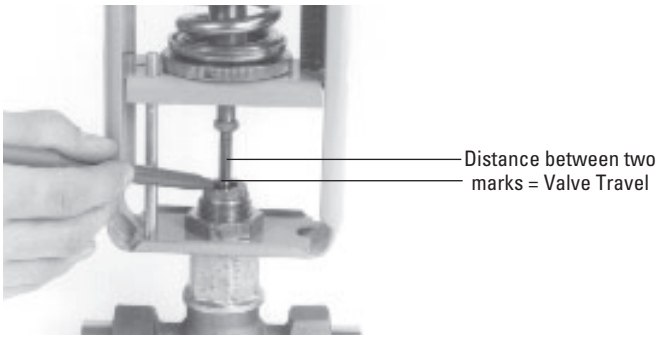
If the valve is not responding to temperature change, test the thermal system.

1. Stop the flow of fluid through the line.

2. DA: Raise the temperature of the bulb above the set point temperature by placing it in a container of hot water. This will cause the plug to fully seat.

   RA: Raise the temperature of the bulb above the set point temperature by placing it in a container of hot water. This will cause the plug to fully open.

3. **Figure 15.** With the valve plug in the desired position, use a felt tip pen to mark the position of the packing gland assembly on the stem.




15. Valve travel

4. DA: Place the bulb in a pan of cool water. Cool the bulb 30°F (16°C) below set point so the valve is fully open.

   RA: Place the bulb in a pan of cool water. Cool the bulb to or beyond the set point so the valve plug is seated.

5. Use the pen to mark the new position of the packing gland assembly on the stem.

6. The distance between the marks is the valve plug travel. This should correspond with the **TRAVEL value in the VALVE DIMENSIONS table on page 14.** No movement or only partial movement indicates the thermal system is defective and should be replaced with a new system.

**WARNING:**

Failure of the #11's thermal system will cause a heating valve to full open and a cooling valve to full close. If either of these valve states results in an unsafe process condition, a high-limit shutdown device, such as a Powers AquaSentry, should be used.

## Preventive Maintenance ■

**WARNING:** Failure of the thermal system will result in a constant rise in temperature (or constant high temperature) of the fluid which you are trying to control.

***Once every three months, inspect the Regulator as follows:***

1. Visually check for leaks from the valve body joints, piping-to-valve connections, packing and stem areas
2. Visually check for excessive corrosion on the regulator, including the bellows, capillary, bulb, thermal system legs, bridge, and yoke. Also check for excessive corrosion on the valve body.
3. Perform the instructions in **Testing the Thermal System** Less than full valve travel may indicate a leak in the bellows, capillary, or bulb, or other problems. This may result in excessive temperature in the process.
4. Test the temperature adjusting nut assembly for freedom of movement (see **Adjust Set Point** for instructions).
5. Remove bulb from the process fluid and check for excessive corrosion, or erosion that may weaken the bulb and/or cause thermal system failure.

## Troubleshooting ■

***• Erratic temperature control (valve cycles too hot/cold)***

1. Valve sized incorrectly. Verify valve selection.
2. Regulator is controlling at incorrect set point. Refer to **Adjust Set Point.**
3. Bulb is poorly positioned and/or oriented, and will not control the actual temperature of the heating/cooling medium. Refer to **Install Bulb.**
4. Incorrect type of bulb is being used. See Table on page 15.
5. The valve stem is sticking. Lubricate the stem.
6. The valve stem is bent. Refer to **Maintenance** for disassembly instructions and replace.
7. Packing gland assembly too tight. Loosen packing gland nut.
8. Faulty or incorrect steam traps. Replace with correct steam trap.
9. Very wet steam. Install a high pressure steam trap just ahead of the valve to drain off condensate that collects in the steam line.

***• Regulator does not shut off***

1. Pressure differential is greater than allowable pressure drop. Refer to **Water Capacities** and **Steam Capacities** tables.
2. Plug and/or seat is worn. Refer to Maintenance. Replace seat and/or valve body plug.
3. Foreign material between the plug and seat. Refer to **Maintenance.** Clean.
4. Bulb is poorly positioned and/or oriented, and will not control the actual temperature of the heating/cooling medium. Refer to **Install Bulb.**
5. Incorrect type of bulb is being used. See Table on page 15.
6. Valve sized incorrectly, causing wire drawing and leakage. Refer to **Sizing Information.**
7. Packing gland assembly is too tight, locking valve stem. Loosen packing gland assembly and lubricate if desired.
8. Bent valve stem; need to replace. Refer to **Maintenance** for disassembly instructions.
9. Thermal system failure. Refer to **Testing the Thermal System.**
10. Temperature adjusting nut assembly raised too high. Refer to **Adjust Set Point.**

***• Regulator controlling at too low a temperature***

1. Temperature adjusting nut assembly raised too high. Refer to Adjust Set Point.
2. Pressure differential is greater than allowable pressure drop. Refer to Water Capacities and Steam Capacities tables.

***• Valve "chatters"***

1. Regulator installed with the flow of the control medium in reverse of arrow direction on valve body.
2. Pressure differential too high, refer Water Capacities and Steam Capacities tables for correct range.
3. Trapped condensate in line. Install a steam trap just ahead of the regulator to drain off condensate that collects in the steam line.

***• Constant rise in process fluid temperature***

1. DA (Heating Valve): A constant rise in temperature may indicate the thermal system is leaking charge and/or the valve has failed in a partially or fully open position. This would allow a constant flow of heating medium, which would overheat the fluid which you are trying to control.
2. RA (Cooling Valve): A constant rise in temperature may indicate the thermal system is leaking charge, and or the valve has failed in a partially or fully closed position. This would slow or stop the flow of cooling medium which would overheat the fluid which you are trying to control.